

Patent Claims

1. Apparatus for determining and/or monitoring the volume and/or mass flow rate of a medium in a containment, especially in a pipe, comprising: At least one ultrasonic transducer, which emits and/or receives ultrasonic measuring signals; a coupling element associated with the ultrasonic transducer, via which the ultrasonic measuring signals are coupled into, and out of, the containment at a predetermined in-coupling and out-coupling angle; and a control/evaluation unit, which determines the volume and/or mass flow rate of the medium flowing in the measuring tube on the basis of the measuring signals or on the basis of measurement data, which are derived from the measuring signals;

characterized in that

the coupling element (11, 12) includes at least two element portions (13, 14), which are embodied and/or arranged in such a manner that the influence of temperature changes on a predetermined in-coupling angle (ζ) into the containment (7) and/or on a predetermined out-coupling angle (ζ) out of the containment (7) is approximately compensated in a predetermined, or extended, temperature range.

2. Apparatus as claimed in claim 1,

characterized in that,

for the case that the in-coupling/out-coupling angle (ζ) of the ultrasonic measuring signals is determined also by the temperature dependence of the medium (2), the element portions (13, 14) of the coupling element (11, 12) are embodied and/or arranged in such a manner that the in-coupling/out-coupling angle (ζ), respectively, into the medium (2) or out of the medium (2), is approximately constant over an extended temperature range.

3. Apparatus as claimed in claim 1,

characterized in that

the element portions (13, 14) are coupling wedges, which are passed through successively by the ultrasonic measuring signals.

4. Apparatus as claimed in claim 1, 2 or 3, characterized in that

the element portions (13, 14), or the coupling wedges, are made of different materials, wherein the materials are so selected that changes of the velocity of sound (c_2) in, or the index of refraction of, the material of a first element portion (13), or of a first coupling wedge, caused by temperature changes are approximately compensated by changes of the velocity of sound (c_1) in, or the index of refraction of, at least a second element portion (14), or of a second coupling wedge, caused by temperature changes.

5. Apparatus as claimed in claim 1, 2 or 3, characterized in that

the element portions (13, 14), e.g. the coupling wedges, are made of plastic.

6. Apparatus as claimed in claim 1 or 2, characterized in that

a plurality of element portions (13, 14), e.g. coupling wedges, of different materials are provided, wherein the materials are so selected that changes of the velocity of sound in, or the index of refraction of, the medium (2) caused by temperatures changes, and changes of the velocities of sound in, or the indices of refraction of, the at least two element portions (13, 14), e.g. coupling wedges, caused by temperature changes, are approximately mutually compensated.

7. Apparatus as claimed in claim 1 or 2, characterized in that

the dimensions of the element portions (13, 14), or the path lengths, which the ultrasonic measuring signals travel in the element portions (13, 14) of the coupling wedges (11, 12), or

of the lead-in members, are so selected that the sum of the corresponding travel times, which the ultrasonic measuring signals require for passing through the element portions (13, 14) is at least approximately constant over a predetermined temperature range.